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## The Cold Spell in May.

BY C. E. P. BROOKS, M.SC.

THE quasi-periodic occurrence of a cold spell lasting for a few days early in May is a well-known popular belief, both in the British Isles and on the continent of Europe. The average date of its occurrence is said to be about May 12th, and on the Continent three "Saint Days," those of St. Mamertius, St. Pancras and St. Gervais, falling on May 11th, 12th and 13th respectively, are popularly known as the *Eisheiligen*, or "Ice Saints." This cold spell appears to play an important part in Messrs. Horner and Robertson's method of forecasting, as set out in their recent work *Simple Weather Forecasting for Everyone.*

If there is any approach to periodicity in the occurrence of such a cold snap, it should be readily recognisable in the mean temperatures for each day of the year, averaged over as long a period as possible.

That this is hardly the case is shown by the table of mean daily values for May 5th to 20th.

In the *Temperature Tables for the British Isles* the mean daily temperatures at Valencia, Aberdeen, Kew and Falmouth were represented by smooth curves (normal curves) calculated from the first two terms of the Fourier series, and the departures of the daily means from the smooth curves were considered. At Valencia the normal curve during May represents the observations very closely; but at Falmouth, Aberdeen and Kew there


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were periods from the 16th to 23rd, 14th to 22nd, and 13th to 23rd respectively when the daily temperatures were 2° to 4° F. below the normal curve. This means that about the third week in May the regular spring rise of temperature was checked, but it does not necessarily mean that there was a periodic occurrence of frosts about that date.

*Mean Daily Values for May 5th to 20th*.*

| May. | 5th. | 6th. | 7th. | 8th. | 9th. | 10th. | 11th. | 12th. |
|---|---|---|---|---|---|---|---|---|
| Greenwich ° F | 50·4 | 50·9 | 51·1 | 50·7 | 51·0 | 51·3 | 51·7 | 52·5 |
| Kew - ° F | 49·9 | 51·1 | 50·9 | 51·3 | 51·1 | 50·8 | 51·0 | 52·5 |
| Berlin - ° F | 51·6 | 54·7 | 54·0 | 54·7 | 55·0 | 55·0 | 54·9 | 56·1 |
| Vienna - ° F | 57·4 | 57·2 | 59·0 | 59·9 | 60·1 | 59·9 | 59·4 | 60·3 |

| May | 13th. | 14th. | 15th. | 16th. | 17th. | 18th. | 19th. | 20th. |
|---|---|---|---|---|---|---|---|---|
| Greenwich ° F | 52·7 | 52·8 | 52·8 | 53·2 | 52·9 | 53·1 | 53·2 | 53·6 |
| Kew - ° F | 52·7 | 52·4 | 52·1 | 51·8 | 51·9 | 52·5 | 51·8 | 52·1 |
| Berlin - ° F | 56·8 | 56·8 | 56·8 | 57·0 | 57·6 | 58·1 | 57·4 | 56·8 |
| Vienna - ° F | 60·0 | 59·9 | 60·6 | 60·8 | 60·6 | 61·3 | 61·3 | 61·7 |

* Greenwich, 1841–1905 : *Reduction of Greenwich Meteorological Observations*, Part 4, 1906; Kew, 1871–1900 : Off. No. 154. *Temperature Tables for the British Islands*, London, 1902. Berlin, 1808–1907. Behre, O. *Das Klima von Berlin*. Berlin, 1908. Vienna, 1775–1874. *Jahrbuch K. K. Zentral-Anstalt für Meteorologie*, 47, 1910.

C. F. Marvin, who investigated irregularities in the annual march of temperature[1] in the eastern United States, concluded that these irregularities, some of which are popularly known there as the " January Thaw," " May Freeze," " Squaw Winter," " Indian Summer," etc., are not periodic, but are merely accidental irregularities in the curve, which will disappear when we have a long enough series of observations.

Allowing, then, that the May frosts are not strictly periodic, can it be said that there is a definite cold spell occurring somewhere between, say, the middle of April and the middle of June, in each year, to which the term can be applied? Two answers are possible, according to our way of regarding the problem. If we regard the sequence of weather types, which govern alternations of warm and cool weather, as independent of the precise season, the answer is negative. If, on the other hand, we regard

[1] *Monthly Weather Review*, 47, 1919, p. 544. Washington, D.C. (with Bibliography).

this sequence as intimately connected with phenomena such as the break-up of ice, which by their nature recur at about the same time each year, then there will be a series of phenomena such as "May frosts" which will be recognisable each year, and to which definite names can be given.

The latter position is taken up by Horner and Robertson, who state that the May cold spell is "quite certainly due to the breaking up of the ice, which flows into the North Atlantic between April and June, and which is generally found in the north-western portion of the ocean north of 38° N. and west of 38° W." One gathers that this outbreak of ice is sudden, and is followed almost immediately by cold weather, due to winds coming directly off the ice-pack.

So far from being "quite certain," this position is untenable when a few physical facts are considered. In the first place the outbreak of ice is not sudden, but the amount found on or near the Newfoundland Great Banks usually increases gradually from January or February until May or June, and subsequently declines equally gradually. In the second place, a careful study of the charts compiled by the late Captain Hepworth for the years 1903 to 1912[1] fails to show any relationship between the amount of ice and the temperature over the British Isles at the same time or for a month or two later.

Thirdly, the distance from Newfoundland to England is nearly 2,000 miles, while the average speed of the Gulf Drift over this distance is under 10 miles a day. Since it is impossible for any temperature effect to be propagated over such a distance by wind alone, and the cooled water takes at least six months to make the journey, we cannot expect any fall of temperature due to this outbreak of ice until the following autumn. On the Continent it should be later still, but we have seen that the May cold snap occurs there slightly earlier. It is even found in Russia, where it occurs a day or two earlier even than in Western Europe. Among other investigations we may refer to the work of K. Almstedt,[2] who concluded that the immediate cause of the cold spell is a régime of northerly winds due to the establishment of an area of high pressure over the North Sea or eastern North Atlantic, and he suggests that the ultimate cause is probably the difference in the rates of warming of land and sea. Similar cold spells in spring are in fact met with in temperate regions in all parts of the world, sometimes under circumstances which render it impossible that polar ice can play any part in their occurrence.

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[1] *Geophysical Memoirs*, Nos. 1, 10. M.O. 210*a* and 210*j*.
[2] *Die Kalterückfalle im Mai und Juni*. Diss. Gottingen, 1913.

## Official Publications.

*Professional Notes No. 29. On the Formation of Thunderstorms over the British Isles in Winter.* By E. V. Newnham, B.Sc. Royal 8vo, 4 pp. Price 6d.

THUNDERSTORMS are rare in winter over eastern England, but they occur sometimes in the west and north. In this note cases of thunderstorms occurring in January during the 8 years 1900–7 have been investigated, with a view to tracing the paths of the air which gave rise to the storms.

For the formation of thunderstorms in summer instability over a height of several thousand feet, caused by a rapid fall of temperature with height, is essential. The author assumes that in winter the same unstable conditions are necessary, but that, solar radiation being relatively feeble, the instability is brought about by the heating by the warm ocean of the lower layers of a cold current of air. He, therefore, expects storms to occur in air which has come from a very cold region and subsequently crossed a considerable stretch of ocean. Investigation shows that this is very frequently the case. Of the thunderstorms occurring in January during the years 1900–4 with south-westerly or westerly winds, in 25 cases the origin of the air was in high latitudes, and in only one case was the origin of the air in low latitudes.

The trajectories of air accompanied by thunderstorms, and in some cases those of air unaccompanied by storms, are drawn for January of each of the years 1900–4 in Figures 1–5.

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*Particulars of Meteorological Reports issued by Wireless Telegraphy in Great Britain and the Countries of Europe and N. Africa.* Royal 8vo, 84 pp. Price 2s. 6d.

THIS publication gives in a concise form details of the meteorological reports broadcasted by wireless telegraphy from both the central and local offices in Great Britain and from the central offices in other countries. The particulars are arranged under the different countries and give details as to the transmitting station, call signal, wave-length, times of issue of the messages, the names and positions of the observing stations, the codes used in the messages, &c. The pamphlet concludes with the specification of the International Code for Meteorological Messages.

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*The Wireless Weather Manual.* Royal 8vo, 24 pp. Price 9d., postage 1d.

MANY people who possess wireless receiving sets are picking up meteorological messages. This pamphlet is intended to explain

to the amateur how he can interpret these messages and utilise them to make a forecast of the coming weather in his own locality. As well, therefore, as details of the issues broadcasted by wireless from the Air Ministry, which include synoptic reports, forecasts, aviation reports and forecasts, and a "general inference," a short explanation is given of how to make synoptic charts from the data given in the messages. Using the data given in the synoptic report issued by wireless telegraphy at 2h, 8h or 19h a weather map can be drawn one hour after the observations are taken.

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## The Royal Meteorological Society.

A MEETING of the Royal Meteorological Society was held on Monday, July 24th, in the rooms of the Royal Society, Edinburgh, Dr. C. Chree, F.R.S., President, in the Chair. This was the second meeting to be held in Edinburgh since the amalgamation of the Scottish Meteorological Society with the Royal Meteorological Society in January, 1921.

The following papers were read and discussed :—

*C. K. M. Douglas, B.A.—Observations of Upper Cloud Drift as an Aid to Research and to Weather Forecasting.*

The paper discusses the wind near the top of the troposphere in different stages of the life-history of a cyclone, following on recent researches under Prof. V. Bjerknes in Norway. The conclusions are based on a large number of observations of high clouds and also on observations by other methods, though these are scarce in really disturbed weather. The pressure distributions aloft, disclosed by the upper winds, are considered in relation to temperature, as the pressure at considerable heights is largely determined by the temperature of the column of air underneath. The results show that there is a complete lack of symmetry in the temperature distribution over a cyclone in its earlier stages, with a great contrast in the temperature of the whole troposphere between the "polar" and "equatorial" currents. When the cyclone has reached its final stage, in which it normally becomes stationary and fills up, the distribution of temperature and wind in the upper air approaches to symmetry round the centre, and the easterly current on the north side often extends throughout the troposphere. The conclusions in the paper are supported by direct observations of temperature when these are available. With regard to weather forecasting, it is found that no simple rules can be drawn up, as the changes in the wind at considerable heights follow rather than precede those near the surface. Observations of high cloud

motion are, however, a valuable supplement to other information, as they throw light on the temperature distribution in the troposphere as a whole.

*J. S. Dines, M.A.—Note on the Effect of a Coast Line on Precipitation.*

The paper discusses a convergence effect which will be found over a coast line when the wind blows along the coast, the low pressure being over the sea and the high pressure over the land. The convergence is due to the greater incurvature which occurs in winds over the land than over the sea. An example is worked out and it is found that under favourable conditions an upward current of 15 feet per minute may be produced over a strip of the earth's surface extending 5 miles on each side of the coast line. An example of precipitation which may have been caused by this effect is given. A somewhat similar effect occurs wherever the pressure gradient varies along a line perpendicular to the isobars, and the following rule is deduced: "In any area where the pressure gradient increases towards the 'High' there will be rising air."

*A. E. M. Geddes, D.Sc. and G. A. Clarke.—Note on Turbulence, as exhibited by Anemometer Records, Smoke, and Cloud Formation.*

The first section of the paper deals with the phenomenon of turbulence and eddy-motion. The effect of this eddy-motion is shown near the surface by the records from a pressure tube anemometer. The turbulence and consequent eddy-motion are seen to depend largely on the nature of the surface over which the air current is travelling. Especially is this the case in so far as eddies affect the direction of the wind. The presence of eddies higher up is rendered visible by the behaviour of smoke from tall chimneys and by the manner in which this smoke is raised and at the same time dissipated laterally. Higher up cloud of the stratus order is formed. These smoke eddies and clouds occur when there is little or no convection due to heated air and therefore their appearance and formation is evidently in accordance with Taylor's theory of eddy-motion. The formation of eddies at the junction of two currents of different temperature and hence of different density is demonstrated by photographs showing the fragments of cloud which form *below* the base of a line-squall or similar cloud.

The second section of the paper describes that interesting variety of cloud intermediate between the normal cirrus and cirro-cumulus types. The changes that this cloud undergoes have long proved a puzzling phenomenon to cloud observers. The change of the cirro-cumulus type, which is generally regarded as a water-droplet cloud, into the ice-crystal structure

of true cirrus is only to be expected at the high altitudes and consequently generally very low temperatures of the levels where this cloud is found, but the great frequency with which the reverse process is to be observed calls for some explanation. A number of lantern slides showing these changes and different varieties of the "cirro-macula," as the cloud is termed, were shown, and the Meeting was invited to offer suggestions upon the point in question.

An Exhibition of representative meteorological instruments was on view in the rooms of the Royal Society.

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# Correspondence.

To the *Editors, Meteorological Magazine.*

## Cloud Nomenclature.

DR. C. F. BROOKS in his proposed definition of cirro-cumulus clouds (*Met. Mag.* 1921, page 158) speaks of these as "composed of ice particles," and says that they produce "no diffraction colours near the sun or moon." Also "at times the tops of cirrus tufts or of cirro-stratus sheets are capped with cirro-cumulus." Dr. Simpson deals effectively with one aspect of the question (*Met. Mag.* 1921, page 219). One would judge that Dr. Brooks wishes to include what has hitherto been called cirro-cumulus in his new definition of alto-cumulus and that the new name is really to be applied to flocculent cirro-stratus. I have never seen orthodox cirro-cumulus capping any sort of cirrus, though it often appears in company with alto clouds (*see*, however, Clayden's *Cloud Studies*, page 50 and Plate 18, where cirro-cumulus and "cirro-stratus" are shewn in one cloud mass. Judging by the plate some observers would call the "cirro-stratus" alto-stratus). Who has yet proved that cirro-cumulus is composed of ice-particles? Johnstone Stoney made a fine attempt ("On the Cause of Iridescence in Clouds," *Sci. Trans. R. Dublin Soc.* III. 1887); but he assumes, like others, that "at the elevation in our atmosphere at which these delicate clouds are formed, the temperature is too low, even in midsummer, for water to exist in the liquid state; they consist, in fact, of tiny crystals of ice, not of little drops of water." And he goes on to argue that the iridescence is caused by the fluttering—in an artificial-looking way—of tiny ice-flakes. Herschel in his *Meteorology* describes an observation of his own of iridescence in which "the coloured bands grew broader and the tints very strong and a tendency to form a corona about the sun was perceived." This seems to imply a definite relationship between

cirro-cumulus and alto-clouds. The argument in Simpson's "Coronæ and Iridescent Clouds" (*Q.J.R.Met. Soc.*, Oct. 1912) seems to me conclusive that cirro-cumulus is more nearly related to alto clouds than it is to cirrus. It does not seem necessary to assume even that the temperature of the cloud particles in cirro-cumulus is excessively low. It is conceivable that super-cooled vapour might condense on ascending fine dust much warmer than itself. Nevertheless, even if all this be granted, it seems a pity to take its name away altogether, and still worse to give that name to another sort of cloud. If the "cirro" is to be dropped then rather than substitute "alto" let some distinctive prefix (say "scombo") be adopted.

R. SUTTON.

*Kimberley, South Africa*, April 24th, 1922.

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## A Modification of the Green Flash.

AFTER 8 p.m. (G.M.T.) this evening the sun was intensely coloured, more vermilion than orange-red. From here it touched the skyline across the main Brighton road valley, on hills nearly two miles distant, fringed with trees. There happened to be one break forming a sharp notch and after the rest of the sun had disappeared below the tree tops a small portion remained visible here. The light first grew yellow, then through yellowish green to green. Instead of this vanishing in the fraction of a second, as usual, it lingered for some seconds, probably three to five. This was so marked that I wondered if by chance a road lamp was visible through the notch. That, however, was not so, for the light suddenly vanished in the usual way.

J. EDMUND CLARK.

*Purley, Surrey, July 10th*, 1922.

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## Steaming Roads.

IN this connection it may be worth recording that on July 4th I left Church Stretton for Shrewsbury by the 9.45 train G.M.T. Up to 9.20 G.M.T. it had been raining steadily and heavily: it then cleared and the sun shone brightly. As we travelled I noticed in one or two spots white steam rising from the furrows in a ploughed field; not all over the field, but here and there.

ELEANOR M. TAWNY.

14, *Northmoor Road, Oxford.*

### An exceptional Lunar Corona.

AFTER a splendid afternoon and evening, at Street, Somerset, Monday, August 7th, a slight shower fell at midnight (G.M.T.). Half an hour later the moon (within a few hours of full) was practically clear against a very slightly opalescent sky. This was so slight that it would have escaped notice had it not been that the moon was surrounded by a most brilliant corona. Outside the bright, nearly white section the orange red band was succeeded by a wider one of intense peacock blue, which in turn merged into a second much fainter one of red, in which the orange shade was less pronounced. This ended in the practically clear sky already described.

The colours of each band showed very little variation in tint as one passed outwards.

The rings from the moon outwards were in the proportions of three, two, three, two lunar diameters. If anything the reds were slightly under two, the blue perhaps as much over three. Hence the full diameter was 10° to 11°.*

During the five minutes, or more, of the watch the colours continued bright. Later on more rain fell, culminating in a torrential ten minutes downpour about 5.15 a.m.

J. EDMUND CLARK.

*Craigellachie, 41, Downscourt Road, Purley, Surrey, 9th August 1922.*

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## NOTES AND QUERIES.

### The Probable Error of a Mean Value: Correction for Increase in the Number of Terms.

MR. A. MACDONELL, of Cann, Shaftesbury, who has been investigating rainfall statistics writes to point out that the formula by which estimates of the probable error of a mean value covering a number of years' observations may be kept up to date is not to be found in the text books.

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* It is computed that the size of the droplets producing this corona was approximately ·01 mm.—Ed. M.M.

The mean for, say, $n+1$ years is different from that for $n$ years, the residuals are different, the squares of the residuals are different, and it is tedious to make the long calculation of the probable error *ab initio*. Mr. Macdonell's method saves all this labour; it may be summarized as follows:—

Let $M_n$ be the mean of $n$ quantities $x_1 \ . \ . \ . \ x_n$ so that

$$M_n = \Sigma_1^n x/n$$

and let $\sigma_n$ be the standard deviation of the $x$'s, so that

$$\sigma_n^2 = \Sigma_1^n (x - M_n)^2/n$$

then the probable error is $E_n$ where

$$E_n = \cdot 6745\, \sigma_n/(n-1)^{\frac{1}{2}}$$

When the values of $M_n, \sigma_n$ and $E_n$ have been computed an additional value of $x$ may become available, for example, when a series of observations covering $n$ years is extended by the addition of another year.

In that case, the first step is to compute $a$, the correction to be applied to the mean value, by the formula

$$a = (x_{n+1} - M_n)/n + 1$$

Then we have

$$M_{n+1} = M_n + a$$

together with the accurate relations

$$\sigma^2_{n+1} = \frac{n}{n+1}\sigma^2_n + na^2$$

$$E^2_{n+1} = \frac{n-1}{n+1} E^2_n + \cdot 4550a^2$$

and the more useful approximate relations

$$\sigma_{n+1} = \left(1 - \frac{1}{2n}\right)\sigma_n + \frac{n}{2}\frac{a^2}{\sigma_n}$$

$$E_{n+1} = \left(1 - \frac{1}{n}\right) E_n + \frac{1}{4}\frac{a^2}{E_n}$$

The following example has been given by Mr Macdonell. The mean rainfall at Shaftesbury for the 39 years, 1881–1919, is 32·57, and the probable error $\pm$ 0·54. The mean for 40 years is 32·55, so that $a$ is 0·02 and the probable error $\pm$ 0·53. The rainfall for 1921 was only 18·31 ins., so that the mean for 41 years is 32·21, $a$ is $-$ 0·34, and the probable error $\pm$ 0·57.

The calculation of the means and of the probable errors of the means may be made very simply by the method shown below; but such a method is obviously liable to accumulated error, and would be undesirable for the calculation of a long series of additional values.

| | Mean. | | Probable Error. | |
|---|---|---|---|---|
| **39** years - - | **32·57** | | | **0·54** |
| 1920 - - | | 31·76 | $\frac{1}{39}$th | −0·01 |
| 40a - - - | | −·81 | $\frac{1}{4}\frac{a^2}{E}$ | +0·00 |
| a - - - | −0·02 | | | |
| **40** years - - | **32·55** | | | **0·53** |
| 1921 - - | | 18·31 | $\frac{1}{40}$th | −0·01 |
| 41a - - - | | −14·24 | $\frac{1}{4}\frac{a^2}{E}$ | |
| a - - - | −0·35 | | | +0·06 |
| **41** years - | **32·21** | | | **0·58** |

It is curious that the probable error of the mean for 41 years should be greater than that for 40 years. Evidently the occurrence of such a remarkably small rainfall in 1921 makes the validity of previous estimates of the true mean open to question.

## The Sound of the Oppau Explosion.

It will be remembered that the investigation* of the audibility in England of the explosion at Oppau, near Mannheim, on September 21st, 1921, led to a negative result. Two important papers dealing with the region of audibility of this explosion have now been published, the first† by Prof. A. de Quervain, President of the International Commission for Investigations on the Sound of Explosions, the other‡ by Herman Zierl of the Bavarian Meteorological Service.

From the reports that have been collected it appears that there was an inner zone of audibility within 100 km. of Oppau and an outer zone generally between 200 and 300 km. from Oppau and extending from South Prussia through Saxony and Bohemia to Switzerland.

As to the meteorological situation we learn that there was a ridge of high pressure over Germany and France so that the surface winds were irregular, but at 2,000 metres and upwards there was a general current from the west. De Quervain considers that this upper wind was strong enough to account for the refraction of the sound waves and to provide a general explanation of the position of the region of audibility.

A footnote on Professor de Quervain's article should be mentioned. Referring to the article in the *Meteorological Magazine*,

* *Met. Mag.*, Vol. 56, 1921, p. 277.

† Zürich, *Ann. Schweiz. Met. Zentralanst*, 1920, Anhang 5, 1.

‡ *Deutsches Met. Jahrb. Bayern*, 1921, E. 1.

November, 1921, he points out that in the Swiss Yearbook for 1908 he put forward the theory in which the zone of abnormal audibility is ascribed to the distribution of wind in the upper atmosphere and applied it to the case of the explosion on the Jungfrau railway, so that his work preceded that of Fujiwhara, to which reference was made in the *Meteorological Magazine*.

A useful bibliography accompanies Zierl's paper. We notice, however, the omission of some of the recent work published in this country, especially of Mr. Miller Christy's detailed accounts of the audibility of continual gunfire during the war* and of Dr. Davison's investigation of the Silvertown Explosion.†

## A new Theodolite Sight.

A PILOT balloon theodolite is always provided with sights fitted on the telescope which are used for " finding " the balloon before it can be seen in the telescope itself. The backsight is generally a " V " but in some patterns an " orthoptic " sight is used, *i.e.*, the observer has to look through a small hole. Of the two devices the former is probably the more satisfactory, but the acute angle of the " V " does not readily assist the eye in centering the foresight. The orthoptic sight, while affording some assistance to those whose eyesight is imperfect, has the disadvantage of cutting off a considerable amount of light, and, unless the eye is placed inconveniently near, the field of view is greatly restricted.

With a view to overcoming these difficulties the backsight shown in the accompanying drawing has been devised by Mr. H. W. Baker, mechanical assistant at Benson Observatory.

This backsight has a wide " V " of 150°, with a vertical slot cut in the middle of the " V." The slot has been found to be of great assistance in centering. The foresight** of the Mark B theodolite for which the new backsight was designed is a bead on the top of a short stem and the advantage of the slot in the backsight is that any lateral error in the position of the observer's eye is noticed at once as it allows light to be seen past the stem. In correct adjustment the bead rests at the bottom of the wide " V " and the the odolite is pointed so that the balloon is seen on top of the bead. The new backsight has been found to be

* *Q.J.R. Met. Soc.*, Vol. 42, 1916, p. 267; vol. 44, 1918, p. 281; vol. 45, 1919, p. 141.

† *Edinburgh, Proc. R. Soc.*, Vol. 38, 1918, pp. 115–29.

** Foresight and backsight are both drawn full size in the diagram. In use the distance of the foresight from the eye is about three times that of the backsight.

satisfactory under all conditions. With a larger sight-radius a foresight bead of greater diameter would be an advantage.

## British Association for the Advancement of Science. Hull Meeting, September 6–13th, 1922.

THE programme of the Meeting at Hull in September will contain a number of features of immediate interest to meteorologists. The Cosmical Physics sub-section of Section A (Mathematics and Physics), which embraces Meteorology, will join the Geography Section in a discussion on "Monsoons," and will also join the Economics and Agriculture Sections in one on "Weather Cycles in Relation to Agriculture and to Industrial Fluctuations." As arrangements stand at present, Dr. G. C. Simpson, F.R.S., will open the first discussion and Mr. G. G. Chisholm and Dr. H. Jeffreys will also speak. Sir William Beveridge will open the second discussion and speakers will include Dr. Simpson.

Papers to be read include one before Section A by Sir Napier Shaw probably on "Convection in the Atmosphere," one before Section B (Chemistry) by Dr. J. S. Owens on "Atmospheric Dust" and one before Section A by Mr. M. A. Giblett on "Some Recent Developments in Synoptic Meteorology." The latter will refer to a demonstration which will be given by the Meteorological Office, Air Ministry on the same lines as at the Meeting in Edinburgh last year (see *Meteorological Magazine*, October, 1921, p. 249) and recently at the Royal Agricultural Show, Cambridge (see *Meteorological Magazine*, July, 1922, p. 161). The main object of this demonstration will be to show how any private individual may intercept and utilise the weather information which is now being broadcasted by wireless telegraphy daily by European countries. A temporary wireless station will be installed in the Guildhall, Hull, and opportunities will be afforded to Members of the Association of seeing the whole process of the reception of coded messages and their transformation into weather maps, which will be exhibited together with forecasts based on them, on a large blackboard in the Reception Room. A "Local Daily Weather Report" will also be produced and copies will be posted in a number of places.

The "Meteorological Luncheon" will probably be held on Thursday, September 7th; details will be given in a notice displayed in the Reception Room during the early stages of the Meeting.

M. A. G.

## The Deep Sea Fishing Exhibition.

AT the invitation of the promoters, the Meteorological Office provided an exhibit at the Deep Sea Fishing Exhibition, held at

the Royal Agricultural Hall from July 24th to August 5th, 1922. The aim was to place before the public the work of the Meteorological Office in its relation to the fisherman and his trade.

The exhibit consisted of diagrams, charts, publications and instruments. The main feature was a large blackboard on which the weather map for north-west Europe was drawn twice a day, the data being received by telephone from the Air Ministry. On two wings to the main board forecasts and explanations were displayed. The North Sea forecast was given special prominence. Considerable interest was shown by the public, the short lectures on the weather map being very popular.

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## Scientific Cruise from Bergen.

DURING May and June of this year a scientific cruise was made by the 28-ton motor-boat the *Armaner Hansen* of Bergen. The primary object of the cruise was to obtain data for the study of the temperature and density of the waters of the Atlantic. Professor Björn Helland-Hansen, of the Geophysical Institute, Bergen, was responsible for Oceanography; Professor D. Damas, of Liége University, for Marine Biology, and Mr. E. G. Calwagen, of the Meteorological Observatory, Bergen, for Meteorology. The expedition left Bergen on April 24th; the following ports of call give some idea of the route followed:—Ostend, Lisbon, Casablanca, Funchal (Madeira), Ponta Delgada (Azores), Ostend. Hydrographical and biological observations were taken at about 40 points. Kites were flown to obtain meteorological observations. The weather reports received by wireless telegraphy were utilised for the regular preparation of maps and forecasts.

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## Disaster to Mount Everest Expedition.

A DISASTER befell the Mount Everest Expedition on June 7th. While making the final effort to reach the summit the climbing party was overtaken by an avalanche and was carried down some distance by the falling snow. Most of the members of the party landed on a ledge and were unhurt, but seven of the porters were buried in a deep crevasse with most of the avalanche on top of them. All hands worked hard for some hours and six of the bodies were recovered. The expedition has been abandoned for this year.

## Whirlwind at Worthing.

THE following note on a whirlwind at Worthing on April 27th has been sent to us:—

> A whirlwind struck Worthing at about 13 h. 10 m. on Thursday afternoon. Two boats were lifted into the air about 25 feet; one was carried a distance of 150 yards and thrown on the beach, being smashed to pieces; the other was carried a distance of 100 yards and thrown against a groine post and the side burst in.
>
> Nine boats in all were severely damaged, but as far as I can learn no other damage was done.
>
> After striking the boats the whirlwind passed along the beach in an easterly direction for about 300 yards, and then altered its course and went out to sea in a south-easterly direction. I lost sight of it in a heavy rain squall.
>
> E. J. SOUTHWOOD, C.O.

*H.M. Coastguard Station, Worthing, April, 27th, 1922.*

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## Meteorology in Poetry.

In *John o' London's Weekly*, July 1st, 1922, under the title *Where are the Songs of Summer*, Mr. Philip Tomlinson gives quotations from English poets.

There is very little with direct bearing on meteorology in these quotations. Perhaps the most interesting is from William Morris—

> The summer night waneth; the morning light slips
> Faint and grey 'twixt the leaves of the aspen, betwixt the cloud bars,
> That are patiently waiting there for the dawn:
> Patient and colourless, though Heaven's gold
> Waits to float through them along with the sun.
> Far out in the meadows, above the young corn,
> The heavy elms wait, and restless and cold
> The uneasy wind rises; the roses are dun;
> Through the long twilight they pray for the dawn
> Round the lone house in the midst of the corn.

In the same number of *John o' London's Weekly* a correspondent quotes from Childe Harold a good example of "Sound and Movement in Poetry."

> "The sky is changed! such a change! O night,
> And storm, and darkness, ye are wondrous strong,
> Yet lovely in your strength, as is the light
> Of a dark eye in woman! Far along,
> From peak to peak, the rattling crags among,
> Leaps the live thunder! Not from one lone cloud,
> But every mountain now hath found a tongue;
> And Jura answers, through her misty shroud,
> Back to the joyous Alps, who call to her aloud!

And this is in the night ! Most glorious night,
Thou wert not sent for slumber ! Let me be
A sharer in thy fierce and far delight—
A portion of the tempest and of thee !
How the lit lake shines—a phosphoric sea—
And the big rain comes dancing to the earth !
And now again 'tis black—and now the glee
Of the loud hills shakes with its mountain-mirth,
As if they did rejoice o'er a young earthquake's birth."

Fine poetry no doubt, but open to criticism as a scientific description of a thunderstorm.

## Reviews.

J. Bjerknes and H. Solberg. *Meteorological Conditions for the Formation of Rain. Geofysiske Publ.*, Vol. II., No. 3. Kristiania, 1921. Size 12 × 9, pp. 60, 1 plate.

FREQUENT references have been made in the writings of Professor V. Bjerknes to a forthcoming publication on the *Meteorol gical Conditions for the Formation of Rain*, written by his son, J. Bjerknes, in collaboration with H. Solberg.

This paper, which is one of a series in which the Norwegian school of meteorologists is developing Bjerknes's theories, is of first class importance and it is not too much to say that it should be studied by all who wish to obtain an insight into the nature of weather changes in north-west Europe.

The material at the disposal of the authors has consisted of the observations at the close network of stations of the Norwegian Meteorological Service. It is remarkable how much may be learned from the combination of good cloud and wind observations with information as to the time of rainfall. Although the work is concerned throughout with conditions in the upper air, no direct use is made of balloon soundings either for winds or for temperature, so that it is on much the same footing as Shaw and Lempfert's *Life-history of Surface Air Currents*.

Amongst the lessons which the authors teach us perhaps the most far-reaching is the importance of regarding the cloud canopy over the country as a connected whole. The familiar representations of a cyclone with cirrus here, stratus there, and cumulus somewhere else are merely confusing. The newer scheme, in which attention is focussed on a single cloud sheet growing thicker and denser from front to rear, is easy to visualise and lends a new interest to every observation. The development of such a cloud sheet is evidence for the gradual thickening of a layer of warm moist air over a colder current We learn to appreciate the significance of tufted cirrus or mare's tails when we realise that the tuft is the cloud formed by the condensation

in the turbulent warm current, and that the tail is the trail* of this cloud as it is scraped, so to speak, over the cold, stable and slow current below.

The detailed study of the development and disappearance of a *régime* of local showers and thunderstorms is of great importance. We learn how long the same air can remain over a small country like Norway, how moist air works its way inland from the sea, making progress during the day, and flowing back to a certain extent during the night until the land is covered by air warm enough and moist enough for local convection to produce rain. On the other hand the gradual invasion of the land by cold dry air under the influence of the general pressure distribution may also take several days and lead to the gradual displacement of the showery conditions by steady fine weather.

We can only hope that this work will find imitators in other countries so that the validity of the generalisations may be thoroughly tested.

F. J. W. W.

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*Notes d'Estudi.* Servei Meteorologie de Catalunya. Barcelona, 1921–22. Size 8½ × 6.

Under the directorship of Dr. E. Fontseri the Meteorological Service of Catalonia is showing great activity. A series of pamphlets entitled *Notes d'Estudi* is now being published for the Meteorological Service by the scientific section of the Institut d' Estudis Catalans. The first number was dated November 1921 and the eighth has been received already. Such subjects as the nomenclature of winds, the movements of the air as shown by clouds, and the use of halos in forecasting have been dealt with. There are also quarterly reports on the rainfall of Catalonia, with monthly totals for about 80 stations.

As a general rule the last page of each pamphlet is utilised for official notices. From one of these we learn that monthly reunions of friends of the Meteorological Service of Catalonia have been arranged. At the first of these the subjects discussed were the meteorological conditions which produced the invasion of mildew in Catalonia in 1921 and the structure of cyclones according to the theories of Bjerknes.

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* Bjerknes and Solberg consider that the trail is made by snow falling from the tuft, but there does not seem to be any reason to suppose that the small crystals of which it probably consists would fall with appreciable speed. I have found that mare's tails can be imitated successfully by dropping ink into a pond when the upper layers are being moved by the wind and the lower layers, being stable after a cold night, are more sluggish.

## News in Brief.

THE Climatological Station at Ranelagh, Dublin, has been closed since the middle of July. Mr. H. Fayle, who maintained it, having left Ireland.

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OWING to the breakdown of communications in Ireland, there have been many gaps in the *Weekly Weather Report* and district values have not been published. One observer writes as follows: "I send reports every week, but no mails have been received here for more than two weeks, until yesterday, when a heavy mail arrived by river. Railways and roads are torn up, bridges are destroyed, and even river navigation is at times prohibited."

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The semi-final of the Air Ministry Interdepartmental Cricket Competition between the Meteorological Office and the Directorate of Supply and Research was played at Eltham on Friday, 14th July. After a keen struggle the Office lost by 5 runs, the scores being 45 and 40.

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The Society of Friends has presented to the library of the Meteorological Office a diary kept by a Mr. John Sanderson at Oustwick in the East Riding of Yorkshire, beginning in the year 1739. The diary contains a short description of the weather each month up to June 1772. There are a few omissions, as the following extract from the year 1764 shews:—

> "It may be note hear that I had much omited my monthly observaion of weather but the after part of this summer became prete favarable so that tho the fore part of tharvist was got bad ye the latter part was a time for geting it very good etc."

For ready reference it is highly desirable to have this diary transcribed and summarised. Is there any reader of the *Meteorological Magazine* who would care to undertake the work?

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"FORMS whereon to write the numerical calculations described in *Weather Prediction by Numerical Process*, by L. F. Richardson,'

have been published by the Cambridge University Press. These are on sale at 2s. the set.

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In an interesting article which appears on the back of the *Monthly Meteorological Chart of the East Indian Seas* for September 1922, entitled "Surface Ocean Currents" by C. S. Durst, the author has used a large number of observations obtained from the logs of ships travelling on various routes to investigate Ekman's theory of the relation between surface current and wind.

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DR J R SUTTON of Kimberley, South Africa, writes regarding a reported shower of frogs at Gibraltar (*Met Mag.* 1921, page 140) that the frogs were probably under the sand of the North Front and came out after rain. These "showers" often happen in South Africa, but the frogs do not come from the sky—they would be smashed to pulp if they did. It is interesting to watch them burying themselves. They go down backwards in soft ground.

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A KITE balloon is now flown daily at the Meteorological Station, Great Wakering, two miles north-north-east of Shoeburyness, for the purpose of making meteorological observations. The balloon is normally flown at a height of approximately 10,000 feet. In order that the balloon and mooring cable should not constitute a danger to aircraft flying in the neighbourhood, the cable is marked with red and white streamers.

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ELEMENTARY Meteorology is now included among the subjects of examination for persons applying for licenses as class B pilots, that is, as pilots of flying machines carrying passengers or goods.

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A very severe typhoon accompanied by a tidal wave wrecked the town of Swatow, at the southern entrance of the Strait of Formosa, on the night of August 2nd. The typhoon is stated to be the worst ever experienced on the China coast and it is estimated that 10,000 Chinese were killed.

# The Weather of July, 1922.

THE weather of July was generally unsettled, except in the extreme north. Rainfall throughout the British Isles was considerably above the average and temperature considerably below. The two depressions which crossed England in a north-easterly direction on the 5th and the 9th were remarkable for the gales in the Channel associated with them.

Reference to *The Weather of the British Coasts* shows how rarely gales have been recorded in the Channel in July.

On the first day of the month the main features of the pressure distribution were a depression between Iceland and Norway, a weak anticyclonic belt stretching from Spain over France to North Germany and another depression beginning to influence the west of the British Isles and causing local gales with rain. The slow advance of the Atlantic depression in a north-easterly direction on the 2nd and 3rd brought the whole of north-west Europe under cyclonic conditions with strong winds and general rain. A new depression which was indicated off the south-west of Ireland on the 4th moved across England on the 5th and 6th causing general rain, which in many places exceeded one inch and locally approached 3 inches. Gales were reported from the Channel during the passage of this depression. By the morning of the 9th the centre was off the coast of Norway and a fairer day was experienced in the British Isles and France, though heavy rain fell locally in showers. On the evening of the 7th a fresh depression was shown off the south-west of Ireland which crossed England in much the same track as its predecessor, causing strong gales in the Channel and heavy rain generally. A paragraph from '*The Yachting World*' states, "During this gale the L. & S.W. Rly. Co's steamer *Vera* took 18 hours to make the journey from Southampton to Jersey. Her captain says the gale was the worst in his experience extending over sixteen years; many of the seas were 30 feet in height or 60 feet from summit to trough." On Sunday the 9th the depression moved into the North Sea with improving weather in the British Isles and much rain in Norway. On Sunday evening another depression threatening the south-west of Ireland seemed likely to repeat the bad weather of the past week but filled up without crossing the British Isles, and a general rise of pressure throughout Monday resulted in the establishment of an anticyclone over the British Isles and North Germany on Tuesday 11th, giving fair weather generally except in Central Europe, where heavy rain was associated with a depression over Austria. On Wednesday the 12th the anticyclone began to give way before a depression over Iceland, and rain fell in the British Isles and Northern France on the Thursday. On Friday the 14th the depression remained stationary off the Hebrides, slowly filling up, but a secondary developing over the British Isles was accompanied by heavy rain and thunderstorms in south-east England and northern France. On Saturday 15th, St. Swithin's Day, the secondary moved into the North Sea, growing deeper, while pressure rose rapidly behind it with improving weather; small amounts of rain fell however in most places causing anxiety to the superstitious. It then moved slowly across to the Baltic with north-westerly winds and showery weather behind it during the following days. During this comparatively fair period the temperature rose considerably in France and Central Europe and sea fogs occurred in the Channel resulting in a collision between the *Remuera* and the *Marengo* on the morning of the 21st. Meanwhile by the evening of the 19th, backing winds and a falling barometer denoted the approach of another depression, which moved in a north-easterly direction giving rain in western districts. The next depression, on the 21st, remained stationary off the west of Ireland but developed a small secondary centred over London on Sunday morning

giving general rain over England which locally in the midlands was very heavy.

During the 24th and 25th pressure rose over the British Isles forming an anticyclonic ridge with generally fair pleasant weather. On the 26th, western and northern districts were again feeling the effects of a deep depression off the Hebrides which moved slowly north without affecting the southern districts. During the 27th and 28th warm air coming round the Azores anticyclone over the comparatively cold waters of the Atlantic caused extensive patches of fog on the route of the Atlantic liners. The last few days of the month were of an unsettled westerly type with depressions passing between Iceland and Scotland. R. A, W.

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During a violent thunderstorm over the Dijon district on the 5th the ninth-century church of Premières was struck by lightning and burnt. Torrential rain, accompanied by high wind, was experienced in Paris on the same night.

On the 17th snow was falling on the Swiss Alps at a height of only 5,000 feet above sea level. Heavy rainfalls in the lower lying regions caused floods in many parts of Switzerland in the third week of the month. Four members of the managing committee of the Swiss Alpine Club were caught in a heavy snowstorm on the Wildelsig ridge on the 23rd and two of them died from exposure.

Very heavy rain fell in Brandenburg and western Germany about the middle of the month. Severe cold was experienced in the Bavarian mountains in the third week of the month and 5 of a party of tourists climbing the Zugspitze were frozen to death.

The Indian monsoon has been slightly stronger than usual and gives good promise for agricultural operations. Excellent rains have fallen over the greater part of the country and there are only a few regions, notably Kathiawar, Cutch and parts of the Punjab where further rainfall is necessary. In some areas of the Deccan there has been about 1,000 mm. of rain and the sun has scarcely been seen for weeks. Two cyclones have occurred in the Bay of Bengal.

At the beginning of the month the temperature at Melbourne fell as low as 32° F. and snow occurred as far to the north-east as Albury on the River Murray. A message from Melbourne dated July 31st stated that the highest flood waters experienced in twenty years were slowly moving down the Murrumbidgee River and had gradually inundated the town of Wagga Wagga. The great Burrinjuck dam, the sixth largest in the world, at the headworks of the Murrumbidgee irrigation scheme, has so far stood the test well, although it is not yet completed.

A telegram from Seattle, Alaska, dated July 6th. stated that Captain Amundsen's ship the *Maud* had been kept back by adverse ice conditions in the Bering Sea. On the 15th the vessel was fixed in the ice in the neighbourhood of Good Hope Bay, Kotzbue Sound. Amundsen's arrival at Point Barrow and his projected aeroplane flight thence across the Polar basin have therefore been delayed.

The United States has had an unusually and persistently wet summer. The English practice of insuring against rain has been widely taken up and the insurance companies have consequently suffered very considerable losses this year.

(*Continued on p.* 202.)

## Rainfall Table for July 1922.

| STATION. | COUNTY. | Aver. 1881–1915. | 1922. | | Per cent. of Av. | Max. in 24 hrs. | | No. of Rain Days |
|---|---|---|---|---|---|---|---|---|
| | | in. | in. | mm. | | in. | Date. | |
| Camden Square | *London* | 2·38 | 3·85 | 98 | 162 | 1·10 | 5 | 22 |
| Tenterden (View Tower) | *Kent* | 2·09 | 2·38 | 61 | 114 | ·78 | 5 | 16 |
| Arundel (Patching Farm) | *Sussex* | 2·40 | 3·83 | 97 | 160 | 1·22 | 5 | 17 |
| Fordingbridge (Oaklands) | *Hampshire* | 2·00 | 4·69 | 119 | 235 | 2·02 | 5 | 21 |
| Oxford (Magdalen College) | *Oxfordshire* | 2·27 | 3·56 | 90 | 157 | 1·14 | 5 | 16 |
| Wellingborough (Swanspool) | *Northampton* | 2·29 | 3·89 | 99 | 170 | 1·50 | 5 | 22 |
| Hawkedon Rectory | *Suffolk* | 2·44 | 3·75 | 95 | 154 | ·70 | 16 | 20 |
| Norwich (Eaton) | *Norfolk* | 2·59 | 7·33 | 186 | 283 | 2·70 | 14 | 20 |
| Launceston (Polapit Tamar) | *Devon* | 2·69 | 3·14 | 80 | 117 | ·80 | 5 | 18 |
| Sidmouth (Sidmount) | „ | 2·51 | 3·54 | 90 | 141 | 1·24 | 5 | 15 |
| Ross (Birchlea) | *Herefordshire* | 2·25 | 4·46 | 113 | 198 | 1·55 | 5 | 17 |
| Church Stretton (Wolstaston) | *Shropshire* | 2·45 | 4·67 | 119 | 191 | 1·20 | 5 | 18 |
| Boston (Black Sluice) | *Lincoln* | 2·20 | 4·49 | 114 | 204 | 1·27 | 5 | 22 |
| Worksop (Hodsock Priory) | *Nottingham* | 2·27 | 3·35 | 85 | 148 | 1·25 | 5 | 17 |
| Mickleover (Clyde House) | *Derbyshire* | 2·45 | 4·02 | 102 | 164 | 1·58 | 5 | 19 |
| Southport (Hesketh Park) | *Lancashire* | 2·86 | 4·81 | 122 | 168 | 1·69 | 5 | 19 |
| Wetherby (Ribston Hall) | *York, W. R.* | 2·50 | 5·84 | 148 | 234 | 1·86 | 5 | 14 |
| Hull (Pearson Park) | „ *E. R.* | 2·34 | 4·80 | 122 | 205 | 1·51 | 5 | 21 |
| Newcastle (Town Moor) | *North'land* | 2·65 | 5·08 | 129 | 192 | 1·37 | 5 | 17 |
| Borrowdale (Seathwaite) | *Cumberland* | 8·46 | 10·00 | 254 | 118 | .. | .. | .. |
| Cardiff (Ely Pumping Stn.) | *Glamorgan* | 3·11 | 5·19 | 132 | 167 | 1·07 | 5 | 20 |
| Haverfordwest (Gram. Sch.) | *Pembroke* | 3·20 | 6·29 | 160 | 197 | ·98 | 17 | 16 |
| Aberystwyth (Gogerddan) | *Cardigan* | 3·86 | 4·79 | 122 | 124 | ·96 | 5 | 10 |
| Llandudno | *Carnarvon* | 2·39 | 2·69 | 68 | 113 | 1·33 | 5 | 19 |
| Dumfries (Cargen) | *Kirkcudbrt.* | 3·24 | 4·74 | 120 | 146 | ·78 | 20 | 21 |
| Marchmont House | *Berwick* | 3·05 | 5·40 | 137 | 177 | ·83 | 6 | 19 |
| Girvan (Pinmore) | *Ayr* | 3·65 | 3·44 | 87 | 94 | ·93 | 26 | 24 |
| Glasgow (Queen's Park) | *Renfrew* | 2·92 | 2·29 | 58 | 78 | ·54 | 8 | 21 |
| Islay (Eallabus) | *Argyll* | 3·41 | 3·95 | 100 | 116 | ·59 | 28 | 24 |
| Mull (Quinish) | „ | 4·05 | 4·51 | 115 | 111 | ·84 | 20 | 23 |
| Loch Dhu | *Perth* | 4·83 | 5·60 | 142 | 116 | 1·00 | 1 | 19 |
| Dundee (Eastern Necropolis) | *Forfar* | 2·74 | 3·25 | 83 | 119 | ·54 | 8 | 19 |
| Braemar (Bank) | *Aberdeen* | 2·57 | 3·46 | 88 | 135 | ·53 | 9 | 19 |
| Aberdeen (Cranford) | „ | 2·96 | 4·40 | 112 | 149 | 1·18 | 8 | 19 |
| Gordon Castle | *Moray* | 3·20 | 3·77 | 96 | 118 | 1·44 | 9 | 20 |
| Fort William (Atholl Bank) | *Inverness* | 4·83 | 5·18 | 132 | 107 | ·75 | 30 | 25 |
| Alness (Ardross Castle) | *Ross* | 3·03 | 3·30 | 84 | 109 | ·52 | 1 | 21 |
| Loch Torridon (Bendamph) | „ | 5·42 | 4·37 | 111 | 81 | ·90 | 20 | 18 |
| Stornoway | „ | 3·03 | 2·52 | 64 | 83 | ·32 | 30 | 22 |
| Loch More (Achfary) | *Sutherland* | 5·35 | 3·77 | 96 | 70 | ·91 | 1 | 24 |
| Wick | *Caithness* | 2·63 | 3·16 | 80 | 120 | ·87 | 9 | 22 |
| Glanmire (Lota Lodge) | *Cork* | 2·90 | 3·74 | 95 | 129 | 1·05 | 7 | 21 |
| Killarney (District Asylum) | *Kerry* | 3·32 | .. | .. | .. | .. | .. | .. |
| Waterford (Brook Lodge) | *Waterford* | 3·24 | 2·94 | 75 | 91 | ·61 | 7 | 19 |
| Nenagh (Castle Lough) | *Tipperary* | 3·14 | 3·46 | 88 | 110 | ·75 | 7 | 24 |
| Foynes | *Limerick* | 3·08 | 3·56 | 91 | 116 | .. | .. | .. |
| Gorey (Courtown House) | *Wexford* | 2·94 | 3·21 | 81 | 109 | ·74 | 8 | 15 |
| Abbey Leix (Blandsfort) | *Queen's Co.* | 3·13 | 3·13 | 79 | 100 | ·44 | 7 | 20 |
| Dublin (FitzWilliam Square) | *Dublin* | 2·56 | 2·30 | 58 | 90 | ·42 | 8 | 22 |
| Mullingar (Belvedere) | *Westmeath* | 3·18 | 3·28 | 83 | 103 | ·54 | 17 | 24 |
| Crossmolina (Enniscoe) | *Mayo* | 3·64 | .. | .. | .. | .. | .. | .. |
| Collooney (Markree Obsy.) | *Sligo* | 3·46 | 4·48 | 114 | 129 | ·91 | 7 | 20 |
| Seaforde | *Down* | 3·19 | 3·65 | 93 | 114 | ·52 | 28 | 24 |
| Ballymena (Harryville) | *Antrim* | 3·43 | 3·86 | 98 | 113 | ·47 | 28 | 24 |
| Omagh (Edenfel) | *Tyrone* | 3·40 | 4·63 | 118 | 136 | ·72 | 28 | 20 |
| Letterkenny Asylum | *Donegal* | 3·50 | 3·96 | 101 | 113 | ·72 | 8 | 25 |

## Supplementary Rainfall, July 1922.

| Div. | STATION. | RAIN. | | Div. | STATION. | RAIN. | |
|---|---|---|---|---|---|---|---|
| | | in. | mm. | | | in. | mm. |
| II. | Ramsgate | 1·88 | 48 | XII. | Langholm, Drove Rd. | 7·59 | 193 |
| ,, | Sevenoaks, Speldhurst | 3·64 | 93 | XIII. | Ettrick Manse | 5·58 | 142 |
| ,, | Hailsham Vicarage | 2·82 | 72 | ,, | North Berwick Res. | 2·74 | 70 |
| ,, | Totland Bay, Aston Ho. | 3·43 | 87 | ,, | Edinburgh, Royal Ob. | 3·74 | 95 |
| ,, | Ashley, Old Manor Ho. | 3·57 | 91 | XIV. | Biggar | 3·63 | 92 |
| ,, | Grayshott | 4·84 | 123 | ,, | Leadhills | 9·17 | 233 |
| ,, | Ufton Nervet | 4·68 | 119 | ,, | Kilmarnock, Agric. Coll. | 2·86 | 73 |
| III. | Harrow Weald, Hill Ho. | 3·43 | 87 | XV. | Dougarie Lodge | 3·55 | 90 |
| ,, | Pitsford, Sedgebrook | 3·62 | 92 | ,, | Oban | 4·33 | 110 |
| ,, | Chatteris, The Priory | 3·10 | 79 | ,, | Holy Loch, Ardnadam | 4·46 | 113 |
| IV. | Elsenham, Gaunts End | 3·29 | 84 | ,, | Tiree, Cornaigmore | .. | .. |
| ,, | Lexden, Hill House | 2·71 | 69 | XVI. | Loch Venachar | 4·95 | 126 |
| ,, | Aylsham, Rippon Hall | 5·12 | 130 | ,, | Glenquey Reservoir | .. | .. |
| ,, | Swaffham | 4·37 | 111 | ,, | Loch Rannoch, Dall | 2·37 | 60 |
| V. | Devizes, Highclere | 3·51 | 89 | ,, | Blair Castle Gardens | 3·38 | 86 |
| ,, | Weymouth | 4·08 | 104 | ,, | Coupar Angus | 2·62 | 67 |
| ,, | Ashburton, Druid Ho. | 5·86 | 149 | ,, | Montrose Asylum | 2·80 | 71 |
| ,, | Cullompton | 3·26 | 83 | XVII. | Logie Coldstone, School | 4·66 | 118 |
| ,, | Hartland Abbey | 3·06 | 78 | ,, | Fyvie Castle | 3·40 | 86 |
| ,, | Penzance, Morrab Gden. | 4·23 | 107 | ,, | Grantown-on-Spey | 3·95 | 100 |
| ,, | St. Austell, Trevarna | 4·70 | 119 | XVIII. | Kingussie, Fasnakyle | 3·57 | 91 |
| ,, | Crewkerne Merefield Ho | 4·71 | 120 | ,, | Fort Augustus | 3·24 | 82 |
| VI. | Clifton College | 3·63 | 92 | ,, | Loch Quoich, Loan | 10·25 | 260 |
| ,, | Ledbury, Underdown | 4·12 | 105 | ,, | Fortrose | 1·55 | 39 |
| ,, | Shifnal, Hatton Grange | 4·35 | 111 | ,, | Faire-na-Squir | 4·91 | 125 |
| ,, | Ashbourne, Mayfield | 4·94 | 126 | ,, | Skye, Dunvegan | 4·06 | 103 |
| ,, | Barnt Green, Upwood | 4·44 | 113 | XIX. | Loch Carron, Plockton | 3·62 | 92 |
| ,, | Blockley, Upton Wold | 4·39 | 111 | ,, | Dornoch, St. Gilbert's | 2·61 | 66 |
| VII. | Leicester, Town Hall Sq. | 4·26 | 108 | ,, | Tongue Manse | 2·20 | 56 |
| ,, | Grantham, Saltersford | 4·96 | 126 | ,, | Melvich Schoolhouse | 3·17 | 81 |
| ,, | Louth, Westgate | 5·06 | 129 | XX. | Dunmanway Rectory | 5·53 | 141 |
| ,, | Mansfield, West Bank | 4·41 | 112 | ,, | Mitchelstown Castle | 2·72 | 69 |
| VIII. | Nantwich, Dorfold Hall | 3·76 | 95 | ,, | Gearahameen | 8·30 | 211 |
| ,, | Bolton, Queen's Park | 4·95 | 126 | ,, | Darrynane Abbey | 5·50 | 140 |
| ,, | Lancaster, Strathspey | 5·39 | 137 | ,, | Cashel, Ballinamona | 2·37 | 60 |
| IX. | Wath-upon-Dearne | 2·54 | 65 | ,, | Roscrea, Timoney Park | 2·64 | 67 |
| ,, | Bradford, Lister Park | 4·24 | 107 | ,, | Ballybunion | .. | .. |
| ,, | West Witton | 4·16 | 106 | ,, | Broadford, Hurdlestown | 4·32 | 110 |
| ,, | Scarborough, Scalby | 4·64 | 118 | XXI. | Kilkenny Castle | 2·39 | 61 |
| ,, | Middlesbro', Albert Pk. | 3·90 | 99 | ,, | Rathnew, Clonmannon | 2·58 | 65 |
| ,, | Mickleton | 2·70 | 69 | ,, | Hacketstown Rectory | 3·19 | 81 |
| X. | Bellingham | 3·90 | 99 | ,, | Balbriggan, Ardgillan | 2·93 | 74 |
| ,, | Ilderton, Lilburn | 4·68 | 119 | ,, | Drogheda | 2·66 | 68 |
| ,, | Orton | 7·19 | 183 | ,, | Athlone, Twyford | .. | .. |
| XI. | Llanfrechfa Grange | 4·05 | 103 | XXII. | Castle Forbes Gdns. | 3·17 | 81 |
| ,, | Treherbert, Tyn-y-waun | 11·92 | 303 | ,, | Ballynahinch Castle | 9·05 | 230 |
| ,, | Carmarthen Friary | 6·37 | 162 | ,, | Galway, Grammar Sch. | .. | .. |
| ,, | Lampeter, Falcondale | 6·51 | 165 | XXIII. | Westport House | 5·98 | 152 |
| ,, | Cray Station | 7·20 | 183 | ,, | Enniskillen, Portora | 4·50 | 114 |
| ,, | B'ham W.W., Tyrmyndd | 7·34 | 186 | ,, | Armagh Observatory | 3·41 | 87 |
| ,, | Lake Vyrnwy | 6·78 | 172 | ,, | Warrenpoint | 3·46 | 88 |
| ,, | Llangynhafal, P. Drâw | 3·46 | 88 | ,, | Belfast, Cave Hill Rd. | 3·91 | 99 |
| ,, | Oakley Quarries | 6·00 | 152 | ,, | Glenarm Castle | 3·68 | 93 |
| ,, | Dolgelly, Bryntirion | 5·50 | 140 | ,, | Londonderry, Creggan | 4·32 | 110 |
| ,, | Snowdon, L. Llydaw | .. | .. | ,, | Sion Mills, Sion House | 4·45 | 113 |
| ,, | Lligwy | 3·15 | 80 | ,, | Milford, The Manse | 4·01 | 102 |
| II. | Stoneykirk, Ardwell Ho. | 3·71 | 94 | ,, | Narin, Kiltoorish | 5·01 | 127 |
| ,, | Carsphairn, Shiel | 4·50 | 114 | ,, | Killybegs, Rockmount | 6·45 | 164 |

## Climatological Table for the

| STATIONS | PRESSURE | | TEMPERATURE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Absolute | | | | Mean Values | | | | |
| | Mean M.S.L. | Diff. from Normal | Max. | Date | Min. | Date | Max. | Min. | ½ max. and min. | Diff. from Normal | |
| | mb. | mb. | °F. | | °F. | | °F. | °F. | °F. | °F. | |
| London, Kew Observatory | 1012·9 | −2·8 | 58 | 25 | 27 | 7 | 47·3 | 36·0 | 41·7 | +1·6 | 39·7 |
| Gibraltar | 1019·8 | +1·0 | 69 | 3, 27 | 46 | 7, 18, 28 | 62·3 | 50·2 | 56·3 | −0·3 | 52·4 |
| Malta | 1015·2 | +0·2 | 64 | 5, 6, 7 | 46 | 9 | 59·4 | 52·8 | 56·1 | +1·4 | 51·7 |
| Sierra Leone | 1010·9 | −0·1 | 94 | 16 | 73 | 17, 22, 27 | 90·6 | 74·6 | 82·6 | +0·3 | 74·5 |
| Lagos, Nigeria | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| Kaduna, Nigeria | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| Zomba, Nyasaland | 1007·4 | −0·4 | 91 | 19 | 62 | 7, 17 28 | 81·3 | 64·7 | 73·0 | +1·3 | .. |
| Salisbury, Rhodesia | 1006·1 | −3·8 | 92 | 19 | 50 | 21, 22 | 81·8 | 56·5 | 69·1 | +0·2 | 63·3 |
| Cape Town | 1013·8 | +0·4 | 97 | 5 | 56 | 9 | 79·8 | 60·9 | 70·3 | +0·3 | 63·4 |
| Johannesburg | 1011·5 | +0·3 | 83 | 17, 23 | 49 | 28 | 76·0 | 55·4 | 65·7 | +0·3 | 56·7 |
| Mauritius | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| Bloemfontein | .. | .. | 91 | 14 | 43 | 20 | 86·4 | 57·9 | 72·1 | +0·2 | 59·8 |
| Calcutta, Alipore Obsy. | 1012·3 | −1·0 | 96 | 26 | 51 | 2 | 87·0 | 59·9 | 73·5 | +2·5 | 63·5 |
| Bombay | 1011·5 | −1·1 | 89 | 6 | 62 | 4 | 84·9 | 70·2 | 77·5 | +1·9 | 68·9 |
| Madras | 1014·3 | +1·5 | 94 | 26 | 61 | 27 | 86·8 | 67·8 | 77·3 | −0·4 | 69·8 |
| Colombo, Ceylon | 1010·7 | +0·1 | 90 | 15 | 68 | 28 | 87·7 | 72·0 | 79·9 | −0·7 | 75·4 |
| Hong Kong | 1015·5 | −3·3 | 73 | 7 | 49 | 27 | 65·0 | 58·1 | 61·5 | +2·4 | 58·5 |
| Sandakan | .. | .. | 89 | 4, 22, 27 | 72 | 3 | 86·1 | 74·7 | 80·4 | +0·3 | 76·9 |
| Sydney | 1013·1 | −0·9 | 83 | 9 | 61 | 6, 28 | 78·4 | 65·6 | 72·0 | +0·8 | 67·5 |
| Melbourne | 1012·6 | −1·9 | 105 | 16 | 48 | 15 | 80·5 | 59·3 | 69·9 | +2·5 | 62·5 |
| Adelaide | 1012·0 | −2·3 | 106 | 11 | 51 | 28 | 88·1 | 62·8 | 75·5 | +1·4 | 61·2 |
| Perth, Western Australia | 1010·8 | −2·3 | 105 | 22 | 50 | 16 | 84·2 | 62·3 | 73·3 | −0·7 | 64·1 |
| Coolgardie | 1009·9 | −2·6 | 112 | 9 | 50 | 16 | 91·8 | 62·1 | 76·9 | +0·9 | 63·8 |
| Brisbane | 1009·6 | −2·6 | 89 | 27 | 65 | 6 | 81·4 | 68·9 | 75·1 | −1·4 | 71·0 |
| Hobart, Tasmania | 1014·3 | +0·8 | 97 | 12 | 47 | 15 | 70·9 | 54·7 | 62·8 | +0·4 | 57·1 |
| Wellington, N.Z. | 1016·9 | +1·6 | 82 | 28 | 41 | 7 | 71·9 | 56·0 | 63·9 | +1·5 | 58·8 |
| Suva, Fiji | 1008·5 | +0·8 | 90 | 1, 8 | 69 | 19 | 87·7 | 72·3 | 80·0 | −0·5 | 77·7 |
| Kingston, Jamaica | 1015·5 | −0·2 | 89 | 27 | 66 | 10 | 85·8 | 67·8 | 76·8 | +0·3 | .. |
| Grenada, W.I. | 1014·4 | +1·0 | 85 | 1, 9 | 70 | 6, 22, 25 | 82·0 | 71·9 | 76·9 | −0·1 | 72·1 |
| Toronto | 1019·2 | +1·2 | 48 | 23 | − 7 | 17 | 33·9 | 19·1 | 26·5 | +4·8 | 22·5 |
| Winnipeg | 1022·3 | +0·5 | 23 | 25 | −25 | 11 | 10·1 | −9·3 | 0·4 | +1·0 | 2·1 |
| St. John, N.B. | 1017·0 | +2·9 | 45 | 20 | −14 | 18 | 28·9 | 11·7 | 20·3 | +0·4 | 17·8 |
| Victoria, B.C. | 1015·8 | −0·1 | 52 | 16 | 25 | 1 | 43·4 | 32·5 | 37·9 | −2·4 | 34·8 |

LONDON, KEW OBSERVATORY.—Prevailing wind direction SW, mean speed 9·9 mi/hr. 1 day with thunder heard, 2 days with snow.

GIBRALTAR.—Prevailing wind direction NW or E. 2 days with gale.

MALTA.—Prevailing wind direction WNW.

SIERRA LEONE.—Prevailing wind direction SW.

SALISBURY, RHODESIA.—Prevailing wind direction easterly.

COLOMBO, CEYLON.—Prevailing wind direction NNW., mean speed 5·0 mi/hr. 2 days with thunder heard.

## British Empire, February 1922.

| TEMPERATURE | | Relative Humidity | Mean Cloud Am'nt | PRECIPITATION | | | | BRIGHT SUNSHINE | | STATIONS |
|---|---|---|---|---|---|---|---|---|---|---|
| Mean | Absolute | | | Amount | | Diff. from Normal | Days | Hours per day | Percentage of possible | |
| Wet Bulb. °F. | Min. on Grass °F. | % | 0–10 | in. | mm. | mm. | | | | |
| 39·7 | 17 | 78 | 6·1 | 1·87 | 48 | + 9 | 14 | 3·2 | 33 | London, Kew Observatory. |
| 52·4 | 36 | 80 | 3·2 | 3·06 | 78 | − 29 | 7 | .. | .. | Gibraltar. |
| 51·7 | 42 | 81 | 5·8 | 0·94 | 24 | − 27 | 9 | 5·1 | 47 | Malta. |
| 74·5 | .. | 63 | 1·1 | 0·00 | 0 | − 7 | 0 | .. | .. | Sierra Leone. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | Lagos, Nigeria. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | Kaduna, Nigeria. |
| .. | .. | 83 | 6·7 | 4·64 | 118 | −158 | 10 | .. | .. | Zomba, Nyasaland. |
| 63·3 | .. | 64 | 3·6 | 4·74 | 120 | − 62 | 12 | .. | .. | Salisbury, Rhodesia. |
| 63·4 | .. | 59 | 2·6 | 0·87 | 22 | + 7 | 4 | .. | .. | Cape Town. |
| 56·7 | 50 | 70 | 5·3 | 3·06 | 78 | − 52 | 12 | 7·9 | 61 | Johannesburg. |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | Mauritius. |
| 59·8 | .. | 57 | 2·1 | 1·09 | 28 | − 60 | 7 | .. | .. | Bloemfontein. |
| 63·5 | 42 | 35 | 0·5 | 0·00 | 0 | − 29 | 0* | .. | .. | Calcutta, Alipore Obsy. |
| 68·9 | 51 | 63 | 0·5 | 0·00 | 0 | − 1 | 0* | .. | .. | Bombay. |
| 69·8 | 56 | 66 | 2·5 | 0·00 | 0 | − 8 | 0* | .. | .. | Madras. |
| 75·4 | 60 | 67 | 5·0 | 2·12 | 54 | + 1 | 6 | .. | .. | Colombo, Ceylon. |
| 58·5 | .. | 83 | 8·7 | 5·49 | 139 | + 96 | 12 | 2·8 | 25 | Hong Kong. |
| 76·9 | .. | 86 | .. | 25·60 | 650 | +406 | 14 | .. | .. | Sandakan. |
| 67·5 | 56 | 70 | 5·5 | 2·55 | 65 | − 51 | 14 | 6·6 | 49 | Sydney. |
| 62·5 | 42 | 57 | 5·0 | 3·63 | 92 | + 48 | 11 | .. | .. | Melbourne. |
| 61·2 | 40 | 39 | 2·6 | 0·05 | 1 | − 16 | 2 | 10·1 | 76 | Adelaide. |
| 64·1 | 44 | 51 | 3·4 | 0·21 | 5 | − 7 | 4 | 9·3 | 71 | Perth, Western Australia. |
| 63·8 | .. | 35 | 3·5 | 0·92 | 23 | + 4 | 3 | .. | .. | Coolgardie. |
| 71·0 | 62 | 75 | 7·1 | 7·55 | 192 | + 27 | 21 | .. | .. | Brisbane. |
| 57·1 | *41 | 68 | 6·6 | 2·55 | 65 | + 28 | 13 | 6·1 | 44 | Hobart, Tasmania. |
| 58·8 | 28 | 72 | 6·4 | 1·07 | 27 | − 56 | 8 | 7·2 | 52 | Wellington, N.Z. |
| 77·7 | .. | 86 | 4·9 | 16·12 | 409 | +152 | 18 | .. | .. | Suva, Fiji. |
| .. | .. | 73 | 4·1 | 0·45 | 11 | − 4 | 5 | .. | .. | Kingston, Jamaica. |
| 72·1 | .. | 75 | 4·9 | 5·07 | 129 | + 57 | 24 | .. | .. | Grenada, W.I. |
| 22·5 | −11 | 57 | 6·7 | 2·95 | 75 | + 9 | 17 | .. | .. | Toronto. |
| 2·1 | .. | .. | 4·5 | 0·74 | 19 | − 1 | 10 | .. | .. | Winnipeg. |
| 17·8 | −14 | 63 | 6·0 | 2·92 | 74 | − 25 | 14 | .. | .. | St. John, N.B. |
| 34·8 | 19 | 83 | 6·1 | 1·99 | 51 | − 39 | 16 | .. | .. | Victoria, B.C. |

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

HONG KONG.—Prevailing wind direction E., mean speed 15·4 mi/hr. 1 day with thunder heard, 3 days with fog.

PERTH.—Prevailing wind direction SE, mean speed 15·2 mi/hr.

HOBART.—1 day with thunder heard.

WELLINGTON, N.Z.—Prevailing wind direction variable.

SUVA, FIJI.—Prevailing wind direction north-easterly. 10 days with thunder heard.

GRENADA, W.I.—Prevailing wind direction E.

(*Continued from p.* 197.)

A stationary depression over the province of Entre Rios in the Argentine at the end of June and beginning of July gave very heavy rains accompanied by gales. As the storm followed a period of six weeks of almost continuous rain the country round Buenos Aires was very extensively flooded. The storm played much havoc in the capital, many parts of which were under water. A few buildings collapsed and there was a general disorganization of transport and industry. The week ending July 12th was cloudy and abnormally warm over the country in general, the temperature on several days being 5° to 10° higher than the normal for the season.

The special message from Brazil states that the rainfalls of the northern and central regions were respectively 48 mm. and 124 mm. above the normal while that of the southern region was 32 mm. below the normal. Temperature was a little above normal over the whole country but a cold period with slight frosts occurred at the beginning of the month. The cane and cotton crops were still feeling the consequences of last month's heavy rain, and wheat was slightly affected by the relatively high temperature. Pressure at Rio de Janeiro was 4 mm. above the normal.

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The rainfall of July was of particular interest in England and Wales where it was unusually heavy. More than the average occurred everywhere and generally the excess reached as much as 50 per cent. The principal areas with small excesses lay along the west coast and in the south-east corner of England. As much as twice the average occurred over considerable areas in Hampshire, Lincolnshire and Norfolk, where 283 per cent. of the average was reached at Norwich.

In England and Wales the rainfall was everywhere greater than 50 mm. (2 in.). Considerable areas, including parts of the Thames Valley, received more than 125 mm. (5 ins.) and as much as 150 mm. (6 in.) in places. In the high land of Glamorgan and the Lake District more than 250 mm. (10 in.) fell.

Although so large an excess in England and Wales is unusual it is only necessary to go back to 1920 to find a July with greater general rainfall than that of 1922.

The large falls for the month can in part be attributed to the widespread heavy rain of the 5th, when over the whole of England and Wales, with the exception of coastal strips in the west and south-east, more than 25 mm. (1 in.) fell. As much as 100 mm. (2 in.) was recorded over a considerable area in the south of England chiefly from about Reading and Haslemere in the north-east to Crewkerne and Wareham in the south-west. At Selborne in Hampshire as much as 72 mm. (2·85 in.) was recorded on that day.

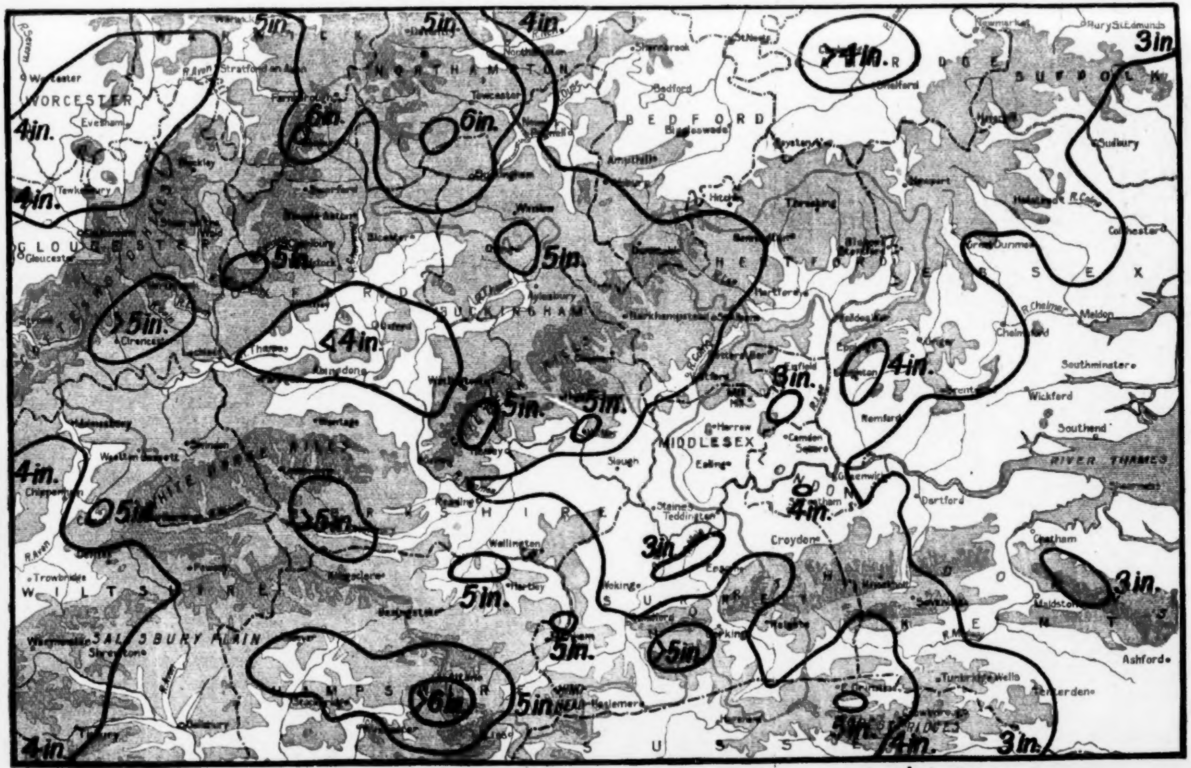
Heavy falls occurred on other days during the month. On the 23rd as much as 67 mm. (2·65 in.) was recorded at Keresley Grange, Coventry, and on the 14th 72 mm. (2·82 in.) at Frankfort Manor to the north of Norwich.

In Scotland and Ireland the rainfall was much more normal. Slightly less than the average occurred in the south-west of Ireland and in the north-west and south-west of Scotland. Excesses of more than 25 per cent. occurred in Co. Tyrone and Aberdeenshire.

The general rainfall expressed as a percentage of the average was: England and Wales 172: Scotland 113: Ireland 112: British Isles 139.

In London, Camden Square, the mean temperature was 59·5° F., or 3·9° F. below the average, the duration of rainfall 59·2 hours, and the evaporation 2·09 inch.

# THAMES VALLEY RAINFALL —— JULY, 1922.




ALTITUDE SCALE

| Below 250 feet | 250 to 500 feet | 500 to 1000 feet | Above 1000 feet |
|---|---|---|---|

SCALE OF MILES 0 5 10 15 20

Watershed of River Thames above Teddington and River Lee above Feildes Weir. ————

Isohyetals.

H.M. Stationery Office Press, Kingsway, W.C.2.

Ps.1673/375. Wt.69. D.P.I. 1000. 8/22.